Hormones That Affect Blood Sugar

- The pancreas contains two types of cells: one type produces digestive enzymes; the other type produces hormones.
- The hormone-producing cells are located in structures called the islets of Langerhans.
- There are more than 2000 tiny islets, each containing thousands of cells.
- The islets contain beta and alpha cells that are responsible for the production of two hormones: insulin and glucagon.
- Insulin is produced in the beta cells of the islets of Langerhans and is released when the blood sugar level increases (after a meal).
- The insulin causes cells of the muscles, the liver, and other organs to become permeable to glucose (lowering blood glucose concentration).
- In the liver, the glucose is converted into glycogen, the primary storage form of glucose (see Fig.1, p. 378).
- If blood sugar levels are low, glucagon (produced in the alpha cells) converts glycogen into glucose to bring levels back.

Diabetes

- Diabetes mellitus is a chronic disease with no cure that affects more than two million Canadians (that number was accurate as of 2000, as of 2010 it is more than three million).
- It is the leading cause of death by disease and if not treated properly can cause blindness, kidney failure, nerve damage and limb amputation.
- Without adequate levels of insulin, the spike in blood sugar after meals remains high (hyperglycemia or high blood sugar).
- This prevents the kidney from absorbing all the blood glucose (glucose appears in urine) and this high concentration of sugar in the urine draws out water - causing excessive thirst and urination.
- Despite the high blood sugar, the cells remain impermeable to glucose and become starved for glucose and must turn to other forms of energy.
- Recall that alternative energy forms often lead to side effects.
- Acetone is produced by excessive fat metabolism and can be smelled on the breath in severe cases of untreated diabetes.

- There are three main types of diabetes mellitus:
  - **Type 1** (or juvenile-onset):
    - occurs when the pancreas is unable to produce insulin because of the early degeneration of the beta cells.
    - usually diagnosed in childhood and must take insulin to live.
  - **Type 2** (or adult-onset):
    - associated with decreased insulin production or ineffective use of insulin.
    - usually diagnosed in adulthood and can sometimes be controlled with diet, exercise and medication (insulin may be necessary).
  - **Gestational**:
    - temporary condition that occurs in 2-4% of all pregnancies.
- increases the future risk of Type 2 diabetes in mother and child and results in large babies

**Adrenal Glands**
- The adrenal glands are located above each kidney
- Each adrenal gland is made up of two glands encased in one shell
- The inner gland, the **adrenal medulla**, is surrounded by an outer casing called the adrenal cortex
- The medulla is regulated by the nervous system, the cortex by the nervous system
- The adrenal medulla produces two hormones: epinephrine (or adrenaline) and norepinephrine
- The hormone producing cells in the medulla are stimulated during times of stress
- In a stress situation, epinephrine and norepinephrine are released from the adrenal medulla into the blood
- These hormones cause:
  - Blood sugar levels to rise (increase breakdown of glycogen)
  - Increase heart rate
  - Increase breathing rate
  - Increase cell metabolism
  - Blood vessels dilate
  - Iris of the eye dilates
- All of this allows the body to be as active as possible ("fight or flight")

- The adrenal cortex produces three types of hormones: the glucocorticoids, the mineralocorticoids, and small amounts of sex hormones (Fig. 5, p.382)
- The glucocorticoids are also associated with blood sugar
- **Cortisol**, one of the most important glucocorticoids, increases the level of amino acids in the blood to help the body recover from long-term stress
- The a.a. are converted to glucose by the liver, raising blood sugar
- The brain identifies stressful situations, and the hypothalamus sends a releasing hormone to the anterior lobe of the pituitary, stimulating the pituitary to release corticotrophin, also called adrenocorticotropic hormone (ACTH)
- The blood carries ACTH to the target cells in the adrenal cortex, which secrete mineralcorticoids and glucocorticoids (including cortisol)
- As cortisol levels rise, they inhibit the release of ACTH, which lowers the levels of all of these hormones (negative feedback)
- Aldosterone is the most important of the **mineralcorticoids**
- Secretion of aldosterone increases sodium retention and water reabsorption by the kidneys, helping maintain body fluid levels

**Homework**
Make notes on Diabetes Research in Canada and Islet Cell Transplants (p.379-380)
p.383 #1-9